

**Assessment Annotations
for the Curriculum Frameworks**

Science

Grades 3, 7, and 10



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SCIENCE ASSESSMENT ANNOTATIONS

FOR THE

SCIENCE CURRICULUM FRAMEWORKS

The benchmark statements in the Science Curriculum Frameworks are at the second, fourth, eighth, and twelfth grades while the science portion of the Missouri Assessment Project will be given at the third, seventh, and tenth grades. In order to provide assistance in curriculum alignment to administrators, curriculum directors, and teachers concerning what is or is not “fair game” content for the science assessment, the attached document was developed by practicing classroom teachers and administrators.

This document includes the left-hand column (“What All Students Should Know”) and the center column (“What All Students Should Be Able To Do”) from the Science Curriculum Frameworks. The third column contains annotations about each benchmark as provided by several teacher work groups and is intended to provide guidance to **CTB/McGraw-Hill**, the assessment contractor. The first strand of the framework (Scientific Inquiry) was considered fair game at all grade levels and is not included in this document.

In the K-4 range, all of the benchmarks at grade two are “fair game” for assessment at grade 3. The benchmarks at grade four will have the words “Grade 3 state assessment” in the third column to denote a benchmark is “fair game” content or the words “Beyond grade 3 state assessment” to denote a benchmark that will not be considered at grade 3. Likewise, at the 5-8 range, the words “Grade 7 state assessment” or “Beyond grade 7 state assessment” will provide guidance. In the 9-12 range, the benchmarks will have annotations that say “Grade 10 state assessment” or “Beyond grade 10 state assessment.” Some of the annotations will be more specific and are self-explanatory. Not all benchmarks identified here as “fair game” for a state test will show up on the test in any given year.

Also, teacher work groups met in late **1996** and early 1997 to decide which of the seventy-three Show-Me Standards should be assessed on a statewide basis through the science performance assessment instrument. These teacher groups identified the following list of standards:

All of the Science Knowledge Standards

Performance Standards, Grade 3 :	1.3, 1.5, 1.6, 1.8, 1.10, 2.1, 3.5, 4.1
Performance Standards, Grades 7 & 10:	1.1, 1.3, 1.5, 1.6, 1.7, 1.10, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 4.1

These standards will be the focus of the performance event of the science portion of the Missouri Assessment Project.

VII. LIVING SYSTEMS---ASSESSMENT NOTES

(SHOW-ME STANDARDS, SCIENCE 3)

- A. Structures/Function/Characteristics**
- B. Life Processes**
- C. Diversity**
- D. Reproduction/Heredity**
- E. Adaptation/Evolution**

K-12 Content Overview:

Observation and classification of living things began with the need of the earliest humans to survive. Human curiosity and desire to organize have led to systems that classify the complex diversity of life based on knowledge of external features, behaviors, internal structures, and molecular evidence.

Understanding and appreciating **the** diversity of life comes from students' ability to see the patterns of similarity and differences that permeate the living world. The living environment consists of millions (perhaps tens of millions) of different types of organisms, all of which carry out the same basic functions that have maintained life for millions of years. The information required to carry out the life functions is encoded in chemicals in the nuclei of cells and is passed **from** generation to generation. A complex interplay between variations in the genetic code and environmental factors results, over **time**, in changes in living organisms.

The challenge for educators is to capitalize on the interest that students have in living things while moving them gradually toward ideas that **make** sense out of nature. Familiarity with the phenomena should precede their explanation, and attention to the concrete object should precede abstract theory. (The "Functions and Interrelationships of Systems" strand within the Healthy Active Living framework contains content related to body systems.)

VII Living Systems A. Structure/Function/Characteristics

What All Students Should Know	What All Students Should Be Able To Do	Grade 3 Assessment Notes
<p><i>By the end of grade 2, all students should know that</i></p> <p>1. Observable characteristics of living organisms can be used to sort and group them.</p>	<p><i>By the end of grade 2, all students should be able to</i></p> <p>a. sort common objects based on color and/or shape and use this skill to sort common organisms. (1.5)</p> <p>b. discover and evaluate patterns and relationships of living organisms. (1.6)</p>	<p>Grade 3 state assessment Do not use dichotomous classification</p>
<p><i>By the end of grade 4, all students should know that</i></p> <p>2. Organisms differ in structure and function and have characteristics that help them survive and reproduce in different environments.</p>	<p><i>By the end of grade 4, all students should be able to</i></p> <p>a. interpret and explain patterns and relationships of the animals structure and systems based on data given about different animals. (1.6; 1.7; 1.8; 2.2)</p>	<p>Grade 3 state assessment</p>
<p>3. Plants and animals are alive and have characteristics that make them different from non-living matter.</p>	<p>a. identify characteristics that determine whether an object or material is living or non-living and apply that knowledge to unknown samples. (1.2; 1.3; 1.6)</p>	<p>Grade 3 state assessment</p>

VII Living Systems B. Life Processes

What All Students Should Know	What All Students Should Be Able To Do	Grade 3 Assessment Notes
<p><i>By the end of grade 2, all students should know that</i></p> <p>1. Organisms go through life cycles.</p>	<p><i>By the end of grade 2, all students should be able to</i></p> <p>a. observe and record the phases in the life cycle of various organisms and compare the differences between species. (1.3; 1.6; 2.4)</p>	<p>Grade 3 state assessment Do not use human life cycles or the term "metamorphosis"</p>

What All Students Should Know	What All Students Should Be Able To Do	Grade 3 Assessment Notes
<p><i>By the end of grade 4, all students should know that</i></p> <p>2. Most organisms require a variety of materials including food, water, air, and a suitable environment for survival. Animals obtain energy and nutrients from plants or other animals.</p>	<p><i>By the end of grade 4, all students should be able to</i></p> <p>a. conduct field investigations to gather data, information, and ideas relating to the energy and nutrients organisms need from their environment in order to survive. (1.3)</p> <p>b. summarize the effect of various conditions on plant and animal survival tactics. (2.1; 2.3)</p>	<p>Grade 3 state assessment Do not use the term “nutrient”</p>
<p>3. Organisms are composed of parts that work together and exhibit behaviors that ensure the survival of the whole organism.</p>	<p>a. discover and evaluate patterns and relationships between the parts of organisms that work together and the behaviors that ensure the survival of the whole organism. (1.7; 1.8)</p>	<p>Beyond grade 3 state assessment</p>

VII Living Systems C. Diversity

What All Students Should Know	What All Students Should Be Able To Do	Grade 3 Assessment Notes
<p><i>By the end of grade 2, all students should know that</i></p> <p>1. Organisms can be grouped by specific structures</p>	<p><i>By the end of grade 2, all students should be able to</i></p> <p>a. group organisms according to similar specific structures. (1.6)</p> <p>b. compare living things using one or more structure attributes. (1.6)</p>	<p>Grade 3 state assessment</p>
<p><i>By the end of grade 4, all students should know that</i></p> <p>2. Some characteristics of organisms are inherited and some are acquired as a result of interaction with the environment.</p>	<p><i>By the end of grade 4, all students should be able to</i></p> <p>a. identify and consider a variety of viewpoints when interpreting whether characteristics are inherited or acquired. (2.3; 3.4)</p>	<p>Grade 3 state assessment</p>

VII Living Systems D. Reproduction/Hereditiy

What All Students Should Know	What All Students Should Be Able To Do	Grade 3 Assessment Notes
<p><i>By the end of grade 2, all students should know that</i></p> <p>1. Most offspring are similar but not exactly like their parents.</p>	<p><i>By the end of grade 2, all students should be able to</i></p> <p>a. identify and discuss the similarities and differences between parents and their offspring. (1.6)</p>	Grade 3 state assessment
<p><i>By the end of grade 4, all students should know that</i></p> <p>2. Organisms resemble their parents because they inherit physical characteristics from them. Organisms with two parents inherit characteristics of both.</p>	<p><i>By the end of grade 4, all students should be able to</i></p> <p>a. organize physical characteristics of offspring and parents into useful forms for communicating visual clarity and interpret patterns and sources of inheritance. (1.6; 3.2)</p>	Grade 3 state assessment Use only animals Do not test that traits are inherited from parents
<p>3. All types of living organisms have offspring, and the similarities between parents and their offspring become more apparent as the offspring mature.</p>	<p>a. conduct field and laboratory investigations to observe and compare similarities and differences between offspring and their parents. (1.3;1.8)</p>	Grade 3 state assessment
<p>4. The phases in the life cycle of all living organisms are predictable, but differ from species to species</p>	<p>a. design and conduct field and laboratory investigations to observe and record the life cycles of organisms. (1.3; 4.6)</p>	Grade 3 state assessment

VII Living Systems E. Adaptation/Evolution

What All Students Should Know	What All Students Should Be Able To Do	Grade 3 Assessment Notes
<p><i>By the end of grade 2, all students should know that</i></p> <p>I. The human body has parts that enable it to live and survive in the world.</p>	<p><i>By the end of grade 2, all students should be able to</i></p> <p>a. organize data, information, and ideas about how human body parts enable the body to live and survive. (1.8)</p>	Grade 3 state assessment Do not use mimicry. Bird beak structures and camouflage okay

What All Students Should Know	What All Students Should Be Able To Do	Grade 3 Assessment Notes
<p><i>By the end of grade 4, all students should know that</i></p> <p>2. Organisms of the same species can have variations which provide an advantage in survival and reproducing.</p>	<p><i>By the end of grade 4, all students should be able to</i></p> <p>a. design and conduct investigations to observe and describe variations in organisms and to predict how the variations provide an advantage in survival and reproduction. (1.3; 1.7; 3.2)</p>	<p>Grade 3 state assessment Do not use variations leading to “reproductive” advantages</p>
<p>3. Fossils give evidence that organisms that lived in the past were both similar to and different from present day organisms.</p>	<p>a. design and conduct investigations to observe similarities and differences in fossils as compared to present day organisms and develop reasonable questions that would account for the differences. (1.3; 1.5; 2.2; 4.6)</p>	<p>Beyond grade 3 state assessment</p>

VII Living Systems A. Structure/Function/Characteristics

What All Students Should Know	What All Students Should Be Able To Do	Grade 7 Assessment Notes
<p><i>By the end of grade 8, all students should know that</i></p> <p>1. Organisms can be classified into five kingdoms based on similarities and differences.</p>	<p><i>By the end of grade 8, all students should be able to</i></p> <p>a. develop and use a classification key that can be used to place common organisms into proper kingdoms. (1.1; 2.4; 3.3; 3.7)</p>	<p>Grade 7 state assessment Use “kingdoms” not “orders”</p>
<p>2. The basic unit of life is the cell. Different cells are specialized to perform various tasks. Cells of similar shape and function are organized into groups.</p>	<p>a. use appropriate technology and other resources to get a visual understanding of the cell as the basic unit of life. Design and conduct field and laboratory investigations to explain why organisms need specialized cells. (1.2; 1.3; 1.4; 2.7)</p>	<p>Grade 7 state assessment</p>
<p>3. In living systems, from cells to biosphere, components interact within a hierarchy of organization.</p>	<p>a. use a variety of technologies and resources to conduct inquiries into a living system and describe the interaction of components and organisms within any living system (1.3; 1.7)</p>	<p>Grade 7 state assessment</p>
<p>4. Cells contain a set of structures called organelles that control the various functions of the cell.</p>	<p>a. use appropriate technology to get a visual understanding of organelles; conduct investigations and research on the structure and function of various cell organelles. (1.2; 1.4; 2.7)</p>	<p>Grade 7 state assessment Limit cell structure questions to plants and animals</p>

VII Living Systems B. Life Processes

What All Students Should Know	What All Students Should Be Able To Do	Grade 7 Assessment Notes
<p><i>By the end of grade 8, all students should know that</i></p> <p>1. Energy is needed for living cells to carry out all the processes of life.</p>	<p><i>By the end of grade 8, all students should be able to</i></p> <p>a. design and conduct investigations and organize data, information, and ideas about how energy is needed for living cells to carry out all the processes of life. (1.2; 1.3; 1.6; 3.1; 4.6)</p>	Grade 7 state assessment
<p>2. In the process of photosynthesis, green plants convert water and carbon dioxide into energy-rich simple sugars and oxygen.</p>	<p>a. conduct simple experiments with green plants to determine the requirements and products of photosynthesis. (1.3; 1.8)</p>	Grade 7 state assessment
<p>3. Complex multicellular organisms are interacting systems of cells, tissues, organs, and organ networks that carry out life processes through chemical and physical means.</p>	<p>a. organize information into a model that demonstrates the interaction of systems of cells, tissues, organs, and organ networks in a complex multicellular organism through chemical and physical processes. (1.2; 1.5; 2.1; 2.3; 2.4)</p>	Grade 7 state assessment

VII Living Systems C. Diversity

What All Students Should Know	What All Students Should Be Able To Do	Grade 7 Assessment Notes
<p><i>By the end of grade 8, all students should know that</i></p> <p>1. A species is an important biological grouping of organisms whose members have similar structures, normally interbred, and produce fertile offspring</p>	<p><i>By the end of grade 8, all students should be able to</i></p> <p>a. review and revise the definition of a species in order to improve understanding and clarity and apply the definition to sample situations. (1.6; 2.2; 2.3; 4.1)</p>	Grade 7 state assessment

What All Students Should Know	What All Students Should Be Able To Do	Grade 7 Assessment Notes
2. Each structure in an organism is uniquely adapted to a particular function for enhancing the ability of the organism to survive.	a. design and conduct investigations and research on how an organism is uniquely adapted to a particular function for enhancing its ability to survive. (1.2; 1.3; 1.4; 2.7; 4.6)	Grade 7 state assessment

VII Living Systems E. Reproduction/Heredit

What All Students Should Know	What All Students Should Be Able To Do	Grade 7 Assessment Notes
<p><i>By the end of grade 8, all student should know that</i></p> <p>1. The combination of genes in sexual reproduction results in a greater variety of possible gene combinations than in asexual reproduction which results in offspring genetically identical to the parent.</p>	<p><i>By the end of grade 8, all students should be able to</i></p> <p>a. present a visual representation of variation in offspring due to sexual reproduction or how asexual reproduction results in genetic clones of the parent. (1.3; 1.8; 3.5; 4.6)</p>	Grade 7 state assessment
<p>2. Chromosomes are components of cells that occur in pairs and carry hereditary information from one cell to its daughter cells, and from a parent to its offspring.</p>	<p>a. use models to demonstrate how genetic material is transmitted and how gene traits are expressed in offspring. (1.3; 2.2)</p>	Grade 7 state assessment Not meiosis or mitosis
<p>3. In sexual reproduction, each gamete contribute a set of chromosomes to the offspring, giving it the traits of both parents.</p>	<p>a. organize data, information, and ideas into a visual representation of the patterns and relationships involved in the chromosome contributions of gametes in sexual reproduction. (1.6; 1.7; 1.10; 2.1; 3.2; 4.6)</p>	Grade 7 state assessment
<p>4. Each cell of a developing organism receives an exact copy of the genetic information contained in the fertilized egg.</p>	<p>a. organize data, information, and ideas to explain the stages through which a fertilized egg or seed changes into its adult form. (1.2; 1.4; 1.8; 2.3)</p>	Grade 7 state assessment

VII Living Systems E. Adaptation/Evolution

What All Students Should Know	What All Students Should Be Able To Do	Grade 7 Assessment Notes
<p><i>By the end of grade 8, all students should know that</i></p> <p>1. Natural selection is the process that ensures individuals with certain traits more likely to survive and have offspring of the same species</p>	<p><i>By the end of grade 8, all students should be able to</i></p> <p>a. research the evolutionary adaptations of a number of present-day organisms and explain how these adaptations contributed to the survival of the organism. (1.2)</p>	Beyond grade 7 state assessment
<p>2. Changes in populations are often, but not always, driven by gradual or catastrophic changes in environmental conditions.</p>	<p>a. evaluate information, ideas, arguments, and products to determine patterns, relationships, perspectives, and credibility relating to changes in populations due to environmental conditions. (1.5; 1.7; 1.8; 2.1; 2.4; 2.6)</p>	Grade 7 state assessment
<p>3. A successful population can adapt to environmental changes through genetic variations.</p>	<p>a. present ideas, opinions, and arguments in an organized and convincing way stating the differences and similarities between successful populations and their environments (2.4)</p>	Beyond grade 7 state assessment
<p>4. The study of fossil records and living organisms provide evidence of the appearance, diversification, and extinction of many life forms.</p>	<p>a. organize information and data to demonstrate the appearance, diversification and extinction of many life forms. (1.5; 2.2)</p>	Grade 7 state assessment

II Living Systems A. Structure/Function/Characteristics

What All Students Should Know	What All Students Should Be Able To Do	Grade 10 Assessment Notes
<p><i>By the end of grade 12, all students should know that</i></p> <p>1. Cells are the fundamental structural and functional units of all living organisms and take highly varied forms in different plants, animals and microorganisms.</p>	<p><i>By the end of grade 12, all students should be able to</i></p> <p>a. use appropriate technology and other resources to compare and contrast ways in which special cells carry out reproduction, photosynthesis, respiration's synthesis, mitosis, meiosis, etc. (1.4; 1.6)</p>	Grade 10 state assessment
<p>2. Cells have distinct and separate structures which perform and monitor processes essential for the survival of the cell and/or organism, such as chemical synthesis, energy conversion, material transport, and cell replication.</p>	<p>a. investigate, observe directly or indirectly, and communicate to others the basic life processes that take place at the cellular level. (1.2; 1.4; 2.1; 2.3)</p>	Grade 10 state assessment
<p>3. DNA indirectly controls what cells do and when they do it by conveying encoded information directing the cell's synthesis of protein molecules.</p>	<p>a. present perceptions and ideas explaining the process whereby DNA directs the synthesis of proteins from amino acids. (2.4)</p>	Beyond grade 10 state assessment
<p>4. Organisms are classified into a hierarchy of groups and subgroups, based on their structural similarities and reflecting as much as possible their evolutionary relationships.</p>	<p>a. classify organisms into groups and subgroups based on structural similarities and then compare to published classifications of the same organisms based on evolutionary and molecular data(1.2; 1.6; 1.7; 1.8)</p>	Grade 10 state assessment

VII Living Systems B. Life Processes

What All Students Should Know	What All Students Should Be Able To Do	Grade 10 Assessment Notes
<p><i>By the end of grade 12, all students should know that</i></p> <ol style="list-style-type: none"> Cells carry out chemical transformations which allow conversion of energy from one form to another, the breakdown of molecules into smaller units, and the building of larger molecules from smaller ones. 	<p><i>By the end of grade 12, all students should be able to</i></p> <ol style="list-style-type: none"> use models to demonstrate various chemical transformations carried out by cells and apply this information to different contexts of everyday life. (1.10; 2.7)) 	Grade 10 state assessment
<ol style="list-style-type: none"> Photosynthesis and cellular respiration are complementary processes. 	<ol style="list-style-type: none"> design and conduct investigations to determine what factors affect the processes of photosynthesis, anaerobic respiration, and aerobic respiration. (1.7; 2.1; 2.2) 	Grade 10 state assessment
<ol style="list-style-type: none"> Optimum conditions are maintained in an organism as a result of special functions performed at the cellular level. 	<ol style="list-style-type: none"> recognize and communicate logical relationships between general body conditions (such as fever or intoxication) and specific cellular processes. (1.6; 2.4; 3.5) 	Grade 10 state assessment

VII Living Systems C. Diversity

What All Students Should Know	What All Students Should Be Able To Do	Grade 10 Assessment Notes
<p><i>By the end of grade 12, all students should know that</i></p> <ol style="list-style-type: none"> Similarities in DNA and protein structure can be used to classify and determine degrees of kinship among organisms 	<p><i>By the end of grade 12, all students should be able to</i></p> <ol style="list-style-type: none"> read and interpret representative examples of published primary articles discussing current research in the use of molecular similarities to determine degrees of kinship of organisms. (1.2; 1.5; 1.7) 	Grade 10 state assessment

What All Students Should Know	What All Students Should Be Able To Do	Grade 10 Assessment Notes
2. Variations of organisms within a species and diversity among species increase the likelihood that at least some organisms will survive in the face of large changes in the environment	a. measure the amount of variation in a defined population of organisms, graph this variation, and relate this variation to the population's ability to survive environmental change. (1.8; 3.5)	Grade 10 state assessment

VII Living Systems D. Reproduction/Heredity

What All Students Should Know	What All Students Should Be Able To Do	Grade 10 Assessment Notes
<i>By the end of grade 12, all students should know that</i>	<i>By the end of grade 12, all students should be able to</i>	
1. Heredity/genetic information is contained in molecules of DNA that consist of various combinations of four different subunits that encode this information.	a. evaluate the accuracy of information provided in the news media regarding current topics related to genetics. (1.7; 1.10; 4.1)	Grade 10 state assessment
2. The pattern of inheritance for many traits can be predicted by using the principles of Mendelian genetics.	a. using existing models that demonstrate patterns of inheritance (i.e., Punnett squares), make predictions as to probabilities and patterns of inheritance for organisms (1.5; 1.6; 1.10; 2.2)	Grade 10 state assessment Single trait dominance only
3. Coding error in DNA synthesis (mutation) can occur randomly during replication and can also be caused by heat, radiation, and certain chemicals.	a. use models of DNA, RNA, amino acids, etc., to demonstrate how mutations affect the structure of proteins. (1.6; 2.1)	Grade 10 state assessment
4. In asexual reproduction of unicellular organisms (and mitosis in multicellular organisms), DNA of parent cells replicates to form identical chromosomes and genes as the cell divides into two identical offspring cells.	a. create a visual representation of the molecular mechanisms that cause asexual reproduction to result in identical offspring and sexual reproduction to result in variation in offspring. (1.3; 2.1)	Grade 10 state assessment

What All Students Should Know	What All Students Should Be Able To Do	Grade 10 Assessment Notes
5. Embryological development in plants and animals involves a series of orderly changes in cell division and differentiation.	a. apply acquired information pertaining to embryological development to responsible decision-making regarding health of developing human fetuses. (1.3; 1.6;1.7;1.10; 3.5)	Grade 10 state assessment

VII Living Systems E. Adaptation/Evolution

What All Students Should Know	What All Students Should Be Able To Do	Grade 10 Assessment Notes
<i>By the end of grade 12, all students should know that</i>	<i>By the end of grade 12, all students should be able to</i>	
1. Evidence for the nature and rates of evolution can be found in anatomical and molecular characteristics of organisms and in the fossil record.	a. examining a real or simulated example of stratified layers of sediment containing fossils and analyze anatomical changes that occur from layer to layer. (1.2; 1.3; 1.6; 1.7; 3.5)	Grade 10 state assessment
2. The process of natural selection provides that some heritable variations that arise from mutation and recombination give individuals within a species some advantage over others for survival.	a. conduct laboratory experiments looking at artificial selection and apply the understanding acquired from these experiments to natural systems in which selection occurs because of environmental conditions. (1.2; 1.3; 1.6; 1.10)	Grade 10 state assessment but not of new species forming or the evolution of a new species
3. Evolution does not proceed at the same rate in all organisms; nor does it progress in some set direction.	a. research our present understanding of the course of evolution, identify random events that may have influenced this course, then predict possible alternative courses which could have resulted had these random events not taken place. (1.2; 1.6)	Beyond grade 10 state assessment